Electro-Technology

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EDITORIAL INDEX

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CIRCUIT DESIGN (see SYSTEMS below)

Amplifier

Complementary Two-Stage Amplifiers, B. Crawford ..... May 48
Complementary amplifier circuits have advantages over conventional types—they are more easily designed and versatile, and have excellent stability. This article develops figures of merit for stability, and details a method for complementary circuit design. Performance figures for a complete amplifier are presented.

Negative Feedback in Transconductance and Transresistance Amplifiers, R. R. Jennings ... Jul 37
An open-loop transconductance amplifier can be transformed by properly applied negative feedback into a voltage, current, or transresistance amplifier, or into an improved transconductance amplifier. Similarly, the transresistance amplifier can be transformed into one of the other basic types or into an improved transresistance amplifier. Methods for accomplishing the transformations and expressions for the characteristics of the resulting amplifiers are presented.

Transistor Amplifier Design, G. E. Giles ..... Dec 42
The design of a high-frequency transistor amplifier is described. The power gain and stability characteristics of a transistor for a common-base connection and a common-emitter connection are determined by using admittance parameters and stability criteria.

Digital; Logic

Digital-to-Analog Conversion Ladders, A. A. Arthur ..... Nov 60
Accuracy of digital-to-analog conversion resistor ladders is analyzed by a worst-case method. Tables of resistor-variation partial derivatives allow simple calculation of over-all circuit accuracy.

Digital Counter Logic, H. F. Najjar ..... Jul 26
A method of designing flip-flop counters with truth tables and Veitch diagram simplification is used to design a two-state counter and two four-stage counters. Basic *R-S*, *T*, *R-S-T*, *D* and *J-K* memory elements are described, and their logical properties are given.

Nanosecond Tunnel-Diode Circuits, W. F. Chow .. Dec 81
Hybrid tunnel-diode/charge-storage diode circuits for high-speed digital logic are discussed. Charge-storage devices have been found superior to pulse transformers for this application. A small arithmetic system, with hybrid circuits and a snap-diode clock generator, is used to test the design. Multilevel logic circuits are described.

SCR Ring Counters, J. Jeansonne ..... Nov 51
Design of SCR ring-counter circuits is simplified if a test circuit is used to determine the values of minimum turn-off capacitance. The operation of the two basic types of SCR ring counter, anode-coupled and cathode-coupled, is described, and design procedures and sample calculations are presented for both.

Switching Speed of a TDTL Inverter, H. C. Josephs ..... Aug 52
The basic TDTL inverter consists of a transistor coupled to the power supply through a tunnel diode. The advantages are unidirectionality, low power consumption, and large circuit-parameter tolerances. The basic circuit is analyzed, and expressions for turn-on and turn-off times developed. The effects of frequency response are discussed.

Filter

Introduction to Filters, A. I. Zverev ..... Jun 61
This comprehensive approach to filters and filter design covers applications, classification and terminology. The image-parameter and polynomial-synthesis design methods are contrasted. Chebyshev, Bessel, Butterworth and Gaussian responses are compared. Emphasis is given to physical realization of filters and to crystal-filter design.

Microwave-Filter Design, A. I. Zverev ..... Dec 46
Microwave-filter types are discussed and described, including transmission-line filters; coaxial, helical, and waveguide cavity filters; and comb, stripline and interdigital filters. Basic design methods are presented and contrasted. Special environmental requirements are discussed.

A New Look at the Parallel Tuned Circuit, D. E. Mertens ..... May 58
Parallel RC and RLC circuits are examined over the entire frequency spectrum using a Bode-plot approach. Impedance, bandwith and parameter variation are analyzed and appropriate approximations are suggested.

Solid-State Low-Frequency Filter, W. Gile ..... Sep 34
The design of a solid-state filter which is suitable for use with frequencies as low as 0.02 cps is presented. The circuit configuration is developed and analyzed, and design results are given.

Integrated

Basic Considerations in Integrated Circuit Design, L. Stern ..... Sep 91
Optimum design of integrated circuits is dependent to a large extent on familiarity with the economics as well as the design freedoms and limitations of the technology. This article relates these basic considerations by discussing what can be integrated, what type of packaging is best, and what type of integrated circuit is most economical.

Subject Classification	Month	Page
Compatible Circuits Highlight Microelectronics Symposium, G. F. Watson ... Advantages of thin-film circuits are combined with those of semiconductor integrated circuits in "compatible" microelectronics. But there are problems in processing and in stability after manufacture. Approaches to these problems were presented at the St. Louis Microelectronics Symposium, April 13-15. Other important topics were a study of microelectronic packaging and a new isolation technique for semiconductor integrated circuits.	Jun	113
Discrete and Integrated-Circuit Transistors, C. Tatom ... Although a discrete transistor and one in an integrated circuit may have very similar geometry, their performance will be different. Here, the 2N918 planar expitaxial transistor is compared with three types of integrated-circuit transistors: 1) *n-p-n*, double base contact; 2) *n-p-n*, single base contact; 3) *p-n-p*, double base contact. Data on *h* parameters between 30 and 350 Mc is analyzed.	Dec	39
Distributed Circuit Design, M. Kahn ... Design methods for circuits using distributed-parameter components are described. These include approximation by lumped components, explicit calculation, and modeling techniques based on frequency transformation.	May	93
An Integrated Harmonic Mixer Circuit, J. E. Thompson ... The two-transistor integrated circuit MC-1110, widely used as a linear amplifier, can also function as a harmonic mixer. A mathematical model for the circuit in this application is developed. A practical mixer circuit incorporating the MC-1110 is discussed.	Nov	97
Microelectronics—Present and Future, An E-T Symposium ... Manufacturers of silicon integrated circuits and of silicon monolithic and thin-film hybrids, and those who make both as well as discrete components, present their views in this symposium. Systems manufacturers give reasons for their choice of one or more of these microelectronic design approaches.	Aug	107
Oscillator		
Thermal Drift of Oscillator Circuits, R. R. Greenwood ... A method is given of estimating circuit performance to take account of thermal drift. A one-transistor voltage-controlled oscillator is analyzed in order to demonstrate the method, and experimental results are presented to verify the estimates made.	Jan	42
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D-C Analysis of Regulated Supplies, W. D. Becher The wide-range regulated power supply (circuit 8-7 of MIL-Handbook 215), which is representative of a widely used type of supply, is analyzed by dividing the circuit into a number of functional sections. The effects on regulation of changes in supply and load are determined, and the results of tests at various ambients are given in tabular and graphic form.	Sep	38
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Complementary Two-Stage Amplifiers, B. Crawford ... Complementary amplifier circuits have advantages over conventional types—they are more easily designed and versatile, and have excellent stability. This article develops figures of merit for stability, and details a method for complementary circuit design. Performance figures for a complete amplifier are presented.	May	48
D-C Memory Comparator Uses FET's, M. B. Leeds ... Field-effect transistors, because they are voltage-controlled and have high input impedance, can eliminate electron tubes in circuits where a reference voltage must be maintained across a capacitor for long periods. Hints for designing this type of FET circuit are given, and the performance of a representative circuit is described.	Nov	104
Stability Criteria for Tunnel-Diode Circuits, B. W. Nelson and R. Masens ... The stability of a tunnel-diode circuit can be determined by a simple procedure. The circuit is designed to satisfy certain prerequisite conditions, and the sufficiency of these prerequisites is then examined by means of a Nyquist stability diagram. Although broad-band and narrow-band amplifiers are used as examples, the general criteria are applicable to sine-wave oscillators, relaxation oscillators, and flip-flop circuits as well.	Jun	52
Switching Speed of a TDTL Inverter, H. C. Josephs ... The basic TDTL inverter consists of a transistor coupled to the power supply through a tunnel diode. The advantages are unidirectionality, low power consumption, and large circuit-parameter tolerances. The basic circuit is analyzed, and expressions for turn-on and turn-off times developed. The effects of frequency response are discussed.	Aug	52
Temperature Dependence in Multivibrators, W. F. Miller ... The principal causes of period variation with temperature in monostable and astable transistor multivibrators are analyzed. Expressions for the period in terms of circuit quantities are developed. Methods of temperature stabilization are discussed, and a stabilization circuit developed by the author is presented.	Aug	38
Tunnel-Diode Applications, T. Mollinga ... A staircase generator is described in which the amplitude and duration of the steps, and the total amplitude, are controlled by tunnel diodes. This circuit does not use a storage capacitor to maintain step levels, and thus simplifies isolation requirements. A balanced modulator is described in which the carrier rejection is 50 db up to 5 Mc. As background information the principles of carrier suppression are reviewed.	Sep	48
The Unijunction Transistor in Relaxation Circuits, B. Crawford and R. T. Dean ... Part 1—Design Criteria. The UJT can be used to simplify certain types of switching circuits. Theory and application of the UJT is quite different from that of the conventional two-junction transistor. This article presents a simplified theory of operation, equivalent circuits, parameter definitions, and salient design criteria for UJT multivibrators. Part 2 will examine representative applications.	Feb	34
The Unijunction Transistor in Relaxation Circuits, B. Crawford and R. T. Dean ... Part 2—Applications. The unijunction transistor is a versatile device. Here are descriptions of its operation in ramp generator, staircase generator, astable multivibrator, ring counter, voltage comparator, pulse generator, motor speed control, and a-c power control circuits.	Mar	40
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Integrated Modules

Miniature Transformer Design, R. E. Smeenge.... Nov 110
Nomographs provide the designer of miniature transformers with a means of obtaining fast estimates of electrical parameters.

Toroidal Inductor Design, H. Blinchikoff ..... Nov 42
Coils can be accurately designed to meet performance requirements by means of a series of nomographs and charts. The basis for this graphical method is explained. Core permeabilities of 60 and 125 are considered, and a detailed design example is presented.

Magnetic Devices

The High-Speed "Relay" Actuator, A. G. Guibert. Mar 119
The "relay" form of actuator, as distinguished from the solenoid, has many small-motion applications. Optimizing design methods are developed, with examples, and performance data are given for a typical design.

Rubber-Bonded Permanent Magnets, Staff Report Aug 99
The general theory of permanent magnets is presented. Design considerations and application notes are included. Particular reference is made to rubber-bonded barium-ferrite composite materials, which have magnetic properties equal to those displayed by isotropic barium-ferrite sintered magnets.

Microwave Components

Hexagonal Ferrites for Millimeter Resonance Isolators, D. R. Taft, G. R. Harrison and L. R. Hodges, Jr. ..... Jan 85
The use of conventional ferrite materials in millimeter and submillimeter resonance devices would require excessively large applied magnetic fields. This problem is apparently solved, however, by the availability of new ferrite materials possessing a hexagonal crystal structure and exhibiting a large effectual anisotropy field. Performance data are given and the composition of the materials is detailed.

Motors, Power

Cryogenically Cooled Motors, J. H. Redmond and F. W. Bott ..... Jul 83
Tests demonstrate the feasibility of operating essentially open-frame a-c and d-c motors submerged in liquid hydrogen and liquid nitrogen. Higher horsepower per pound, greatly increased efficiency and simplification of motor-pump systems design are among the significant advantages to be obtained in such environments.

Hysteresis Motor Flutter, N. A. Miller..... Jul 123
If the two component fields in a hysteresis split-phase motor are not balanced and in 90-deg time phase, or if saturation exists, the motor will exhibit flutter. Methods of flutter measurement and control are outlined.

The Solar Cell—Radiant to Electrical Energy, M. F. Amsterdam ..... Sep 54
The inherent simplicity of the basic physics involved in the functioning of solar cells is presented. The electrical phenomena and basic characteristics of silicon and gallium-arsenide cells are discussed.

Optical and Infrared Devices

Optical Receiving Devices, M. Ross ..... Apr 93
Optical receiving devices, including photoemissive, photoconductive, photovoltaic, photoelectromagnetic and quantum devices, are described. Noise considerations and power gain and loss are covered in some detail. Photomixing and modulation and receiving techniques are discussed.

Printed and Embedded Circuits

Integrated-Circuit Fabrication, N. Formigoni..... Dec 90
The fabrication of semiconductor integrated circuits is described. Epitaxial growth, photoresist etching, and diffusion are discussed in detail. Present capabilities to make integrated-circuit components are indicated. Possibilities for improvements and the future use of integrated circuits are assessed.

Semiconductor Devices

Biasing FET's for Zero D-C Drift, L. L. Evans.... Aug 93
In field-effect transistors, the variation of drain current with temperature can be held to very low levels by proper selection of the bias point. Expressions are developed for this zero-drift bias point and for the drift at other bias points. Zero-drift circuits are also discussed.

Effect of Temperature on FET Characteristics, L. J. Sevin ..... Apr 103
Points of zero temperature coefficient exist for both the static transfer characteristic and the transconductance of FET's; this is caused by the opposing variations of drift mobility and junction contact potential. Expressions are developed for these temperature zeros. Using these expressions, the bias points of zero temperature coefficient can be predicted from two simple measurements.

1/F Noise in Transistors, M. J. Wiggins ..... Dec 34
Circuits can be optimized for low-noise performance at low frequencies without excessive deterioration of their high-frequency performance. However, noise performance of transistors varies widely, even among those of the same type, at low frequencies. A method of determining conditions for optimum noise on an individual basis is described.

Protection of Rectifiers with Circuit Breakers, L. W. Reinken ..... Feb 89
The special problems in protecting rectifier equipment, especially variable-voltage equipment, are discussed, and preventive means (including circuits) are suggested. Some of the methods are equally applicable to variable-voltage a-c supplies, which do not include rectification. Special problems relating to selenium and silicon rectifiers are covered.

SCR's in Automatic Power Control, B. Berman ... Dec 106
The combination of SCR's and magnetic amplifiers (for gate triggering) provides control of both the armature and the field of the motor to achieve constant torque and constant horsepower ranges.

SCR Phase Control of Inductive Loads, F. W. Gutzwiller ..... Apr 119
Use of silicon controlled rectifiers (SCR's) in systems which operate off of standard supply lines (120, 240 volts) is described. In particular, circuit designs of control systems where the load is inductive (transformers, motors, etc.) are shown.

Thermal Stability in Transistors, T. Mollinga ..... Jan 26
A simple amplifier is used as the basis for an analysis of temperature rise in transistors. From this analysis, a graphical method is derived for determining thermal stability, current, voltage, and temperature rise at thermal equilibrium.

The Unijunction Transistor in Relaxation Circuits, B. Crawford and R. T. Dean ..... Feb 34
Part 1—Design Criteria. The UJT can be used to simplify certain types of switching circuits. Theory and application of the UJT is quite different from that of the conventional two-junction transistor. This article presents a simplified theory of operation, equivalent circuits, parameter definitions, and salient design criteria for UJT multivibrators. Part 2 will examine representative applications.

The Unijunction Transistor in Relaxation Circuits, B. Crawford and R. T. Dean ..... Mar 40
Part 2—Applications. The unijunction transis-

tor is a versatile device. Here are descriptions of its operation in ramp generator, staircase generator, astable multivibrator, ring counter, voltage comparator, pulse generator, motor speed control, and a-c power control circuits.

Transducers

Nuclear-Resonance Sensing of Mechanical Motion, R. Zito, Jr. ..... Jun 43
A device employing nuclear radiation sources (radio-isotopes) in conjunction with suitable detectors can be used to provide precise mechanical position and velocity measurements. The Mossbauer effect is utilized by a resonant gamma-ray detector for the quantitative sensing of relative motion.

DESIGN CONSIDERATIONS

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Cost: A Reliability Factor, P. H. Fowler ..... Sep 101
Techniques for analyzing equipment reliability and cost are presented. Examples are given to show that reliability calculations must have an explicit value term. It is shown that large savings can be realized by using reliability and cost analysis in terms of the over-all system.

Environmental Factors

Cryogenically Cooled Motors, J. H. Redmond and F. W. Bott ..... Jul 83
Tests demonstrate the feasibility of operating essentially open-frame a-c and d-c motors submerged in liquid hydrogen and liquid nitrogen. Higher horsepower per pound, greatly increased efficiency and simplification of motor-pump systems design are among the significant advantages to be obtained in such environments.

Vibration Control: Applications, J. E. Ruzicka .... Jan 75
The basic physics of vibration transmission was studied in our August 1963 Science & Engineering feature, "Vibration Control." Selected aerospace electronics applications are described to demonstrate the effectiveness of vibration isolation and structural damping vibration-control techniques.

Fabrication Factors

Integrated-Circuit Fabrication, N. Formigoni ..... Dec 90
The fabrication of semiconductor integrated circuits is described. Epitaxial growth, photoresist etching, and diffusion are discussed in detail. Present capabilities to make integrated-circuit components are indicated. Possibilities for improvements and the future use of integrated circuits are assessed.

Mechanical Design Aspects; Packaging

Linear Vibration Analysis, J. Sklerov ..... Jun 103
The methods of operational calculus are applied to the solution of mechanical vibration problems. The methods are illustrated by obtaining solutions for various inputs to a mechanical system.

Electronic Package Design, C. A. Harper..... Nov 89
Recently, numerous developments in electronic package design have appeared, including the shell-packaged module, the repairable module and the transfer-molded module. Ways to convert from a present package design and plastic materials used for embedding electronic modules are described.

Noise and Interference

Transmitter-Receiver Pairs in EMI Analysis, J. H. Vogelman ..... Nov 54
Electromagnetic interference analysis consists of examining combinations of simple elements (i.e., transmitter-receiver pairs) to find if the output from a given transmitter is large enough to cause interference in a given receiver. The large number of such pairs necessitates computer analysis; however, understanding of EMI mechanisms is prerequisite. Emphasis in this article is on interference between wires in a system.

Reliability

Built-In Reliability, F. A. Applegate ..... Oct 40
A comprehensive reliability program to obtain a product with built-in reliability is described, together with methods for collecting and analyzing reliability data. Techniques to achieve economical testing and manufacturing are outlined.

Cost: A Reliability Factor, P. H. Fowler..... Sep 101
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Estimating Weibull-Distribution Parameters, J. V. J. Ravenis II ..... Mar 46
The usefulness of the Weibull distribution for representing electronic-equipment failure is limited by mathematical complexity. Methods are developed for estimating Weibull parameters. The errors involved in the estimation are analyzed, and examples are given.

Extrapolating Component Life Tests, C. L. Toye .. Oct 36
A summary is presented of the techniques used to estimate component-reliability extrapolating time and environment. Methods discussed extend from simple time, stress and Arrhenius extrapolation to the more advanced matrix life testing, multiple-regression analysis, and contour plotting. Advantages and disadvantages of each technique are considered.

Predicting System Checkout Error, W. D. Moon .. Jan 46
During system and component testing there may be either a failure to detect an existing defect or the false detection of a nonexistant defect. This article discusses methods to estimate both types of test errors. The probability equations developed may also be used to specify the design of new test equipment.

Protection of Rectifiers with Circuit Breakers, L. W. Reinken..... Feb 89
The special problems in protecting rectifier equipment, especially variable-voltage equipment, are discussed, and preventive means (including circuits) are suggested. Some of the methods are equally applicable to variable-voltage a-c supplies, which do not include rectification. Special problems relating to selenium and silicon rectifiers are covered.

Simplifying System-Reliability Calculations, J. G. Lawrence..... Mar 109
A method based on Bayes' theorem simplifies complex system-reliability calculations. Several sample calculations are given, including those for series-parallel and switched systems. An example of a standard reliability calculation is given for comparison.

System Reliability: Redundant Networks, G. D. Weinstock..... Aug 26
In applying redundancy for reliable networks, non-series-parallel circuits may be evolved. These may be analyzed by reduction to equivalent series-parallel forms. A method for the conversion is outlined.

Space and Weight Factors

Microelectronics—Present and Future, An E-T Symposium..... Aug 107
Manufacturers of silicon integrated circuits and of silicon monolithic and thin-film hybrids, and those who make both as well as discrete components, present their views in this symposium.

Systems manufacturers give reasons for their choice of one or more of these microelectronic design approaches.

Thermal Design Factors

Graphical Heat-Transfer Estimation, R. P. Benedict ..... Mar 93
Graphs depicting heat-transfer coefficients for use in free- and forced-convection problems as well as in radiation problems are given. Sample problems are solved to illustrate the use of the graphs.

Thermal Drift of Oscillator Circuits, R. R. Greenwood ..... Jan 42
A method is given of estimating circuit performance to take account of thermal drift. A one-transistor voltage-controlled oscillator is analyzed in order to demonstrate the method, and experimental results are presented to verify the estimates made.

Thermal Stability in Transistors, T. Mollinga ..... Jan 26
A simple amplifier is used as the basis for an analysis of temperature rise in transistors. From this analysis, a graphical method is derived for determining thermal stability, current, voltage, and temperature rise at thermal equilibrium.

DESIGN ENGINEERING TECHNIQUES

Applied Mathematics

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The usefulness of the Weibull distribution for representing electronic-equipment failure is limited by mathematical complexity. Methods are developed for estimating Weibull parameters. The errors involved in the estimation are analyzed, and examples are given.

Matrices for Basic Two-Port Networks, E. H. Kopp ..... Mar 34
Sixteen useful and interesting two-port networks are discussed. These circuits are classified as reciprocal or nonreciprocal and passive or active types. Sets of matrix parameters for each of these circuits are given to aid in analyzing and synthesizing multiple interconnections of these two-port networks.

Transistor Amplifier Design, G. E. Giles..... Dec 42
The design of a high-frequency transistor amplifier is described. The power gain and stability characteristics of a transistor for a common-base connection and a common-emitter connection are determined by using admittance parameters and stability criteria

Uncertainties in Measurement, R. P. Benedict..... Oct 51
Uncertainty in a result is related to uncertainties in measurements of variables. The maximum uncertainty of a result that is related to one or more measured variables can be determined for many common functional forms by the use of a few simple rules.

Computer Applications; Programming

Computer Programs for Circuit Design, H. Falk ... Mar 101
Programs for digital computation of circuit designs are listed. These include the design of transistor circuits, filter networks and general circuits. A description of each program is given with its availability and source.

Computer Simulation of Digital Systems, A. Baker ..... Sep 87
A method of simulating the logical operation of digital hardware by means of computer programs is described. Simulation of a typical two-stage flip-flop counter is used to explain the input format, calling sequences, and over-all method. A glossary of computer-simulation terminology is provided.

Digital Computers in Communications Design, D. Wood, J. P. Healy and R. Lee ..... Feb 39
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Network Analyzer for System Simulation, J. M. Spurlock and J. I. Gonzales ..... Mar 126
A portable, passive-element network analyzer, when programmed, becomes an electrical model of a physical system rather than a computer for the solution of mathematical models. A simulation problem is described to illustrate its application.

Graphical Methods

Miniature Transformer Design, R. E. Smeenge .... Nov 110
Nomographs provide the designer of miniature transformers with a means of obtaining fast estimates of electrical parameters.

ECONOMIC AND SOCIAL CONSIDERATIONS

Economics

Gearing Military R & D to Economic Growth, R. A. Solo ..... Jun 93
R & D activities have skyrocketed—but has economic growth automatically followed? It has not. Ways of making the most, economically, of our R & D efforts are proposed.

Program Evaluation

Project Control Using PERT, R. A. Frantz, Jr. and L. B. Nothern ..... Aug 87
An introduction to the Program Evaluation and Review Technique, a result of a U.S. Navy research task, which provides faster information flow, more accurate appraisal of progress, and tighter management control. It is being used in many military development efforts and has also been applied to some civilian projects.

MATERIALS

Conductive and Resistive

Nickel and Nickel Alloys—Electrical/Electronic Design Parameters, J. L. Shaw and F. L. Perry ..... May 101
Properties of nickel and nickel alloys are related to their applications in springs for switches and relays, magnetostrictive transducers, electron-tube elements and glass/ceramic-to-metal seals, and in film and foil form.

Electrical Insulating and Dielectric

Dielectrics in 1963: Phenomena/Materials/Devices, A. E. Javitz ..... Feb 97
A selective review of current research work in solid, gaseous and liquid dielectrics as reported at the 1963 Conference on Electrical Insulation of the National Academy of Sciences-National Research Council. Among other subjects, photoconductivity phenomena, life studies and breakdown mechanisms, measurement techniques and instrumentation are discussed.

Magnetic

Hexagonal Ferrites for Millimeter Resonance Isolators, D. R. Taft, G. R. Harrison and L. R. Hodges, Jr. ..... Jan 85
The use of conventional ferrite materials in millimeter and submillimeter resonance devices would require excessively large applied magnetic fields. This problem is apparently solved, however, by the availability of new ferrite materials possessing a hexagonal crystal structure and exhibiting a large effectual anisotropy field. Performance data are given and the composition of the materials is detailed.

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Mechanical and Structural

Nickel and Nickel Alloys—Electrical/Electronic Design Parameters, J. L. Shaw and F. L. Perry ..... Properties of nickel and nickel alloys are related to their applications in springs for switches and relays, magnetostrictive transducers, electron-tube elements and glass/ceramic-to-metal seals, and in film and foil form.	May	101

SCIENCE AND ENGINEERING

Communications Theory

Communication and Statistical Decision Theory, D. Middleton..... Decision theory is presented as a means for handling communications situations where the system outputs are "yes-no" or measurement decisions. The limitations and applications of decision theory are discussed. Emphasis is given to system optimization and comparisons, the likelihood ratio, the matched filter, and canonical results. Examples of optimum signal detection and extraction are presented.	Nov	65
Geometry of Automatic Character Recognition, R. Townsend ..... Basic principles of magnetic ink and optical character recognition using the concept of an *n*-dimensional space are discussed. Methods of measurement and categorization of characters are described.	May	54
The Matched-Filter Concept, H. M. Sierra ..... The matched filter is defined and the criterion for matching is derived for stationary white noise. Basic properties of matched filters are deduced in a discussion which considers time- and frequency-domain analysis as well as the use of autocorrelation and cross-correlation.	Aug	48
Millimeter-Wave Generators, L. Nichols, R. Edwards and H.-J. Krahn..... Basic principles of generating and amplifying r-f power at millimeter wavelengths (30 to 500 Gc) are given. Devices now being used for these purposes are described, and their advantages and disadvantages are discussed. Some important research approaches to millimeter-wave generation, using entirely new concepts, are included.	Sep	63

Materials Science

Dielectrics in 1963: Phenomena/Materials/Devices, A. E. Javitz ..... A selective review of current research work in solid, gaseous and liquid dielectrics as reported at the 1963 Conference on Electrical Insulation of the National Academy of Sciences-National Research Council. Among other subjects, photocondictivity phenomena, life studies and breakdown mechanisms, measurement techniques and instrumentation are discussed.	Feb	97

Mathematics

Coefficients of Partial Fractions, V. R. Riggins .... Methods of determining the coefficients of partial fractions are related to the use of Laplace transforms in circuits and physical systems. Coefficient determination is discussed for the cases where the denominator polynominal roots are simple and real, repeated and complex.	Sep	44
Factoring Polynomials by Iteration, Y. L. Luke ... Iterative methods for factoring polynomials are presented with examples of computations. RPR, Lin, Friedman and Bairstow methods and a generalization of the RPR method are considered. Error analysis and obtaining second-order convergence are considered for each method.	Aug	30
A Useful Polygonal Function, R. P. Benedict..... When linear relations are involved, the polygonal function developed here can be used to represent exactly the given data. The function can be obtained with far less effort than the usual least-square polynomial fitting equations. Several examples are given to illustrate the function's use.	Jan	38
The Roots of Polynomials, A. J. Sykas ..... Basic polynomial information and exact formulas for 2nd-, 3rd- and 4th-degree polynomials are listed. The Bernoulli and Graeffe approximation methods and the Bairstow and Newton refinement methods are presented. Calculation techniques and error considerations are discussed.	Apr	109

Measurement Theory

UHF Measurements, M. Magid..... Basic considerations in measurements at microwave frequencies are discussed. Measurement of impedance, frequency phase shift, power and attenuation, and insertion loss are treated. Emphasis is given to the principles of the measuring systems and to the possible sources of measurement error.	Oct	67

Network Theory

Coefficients of Partial Fractions, V. R. Riggins .... Methods of determining the coefficients of partial fractions are related to the use of Laplace transforms in circuits and physical systems. Coefficient determination is discussed for the cases where the denominator polynominal roots are simple and real, repeated and complex.	Sep	44
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System Reliability: Redundant Networks, G. D. Weinstock..... In applying redundancy for reliable networks, non-series-parallel circuits may be evolved. These may be analyzed by reduction to equivalent series-parallel forms. A method for the conversion is outlined.	Aug	26

Physics

Basic Structural Analysis, F. A. Eckman ..... Structures for electronic equipment are exposed to a variety of stresses, often severe or complex. The behavior of beams, plates, columns and torsion-resisting elements when loaded in tension, compression, torsion and their combinations is analyzed to develop fundamental design and evaluation methods for structures.	May	67
Engineering Mechanics: Statics, S. K. Fenster .... The effects of forces on bodies are of fundamental concern in engineering. Statics, the study of equilibrium conditions, is prerequisite to the broader subject of dynamics. Principles are illustrated by numerical examples.	Aug	63
Graphical Heat-Transfer Estimation, R. P. Benedict ..... Graphs depicting heat-transfer coefficients for use in free- and forced-convection problems as well as in radiation problems are given. Sample problems are solved to illustrate the use of the graphs.	Mar	93

The Near Electromagnetic Field, C. L. Marquardt ..... Jan 55
An analysis of the electromagnetic field at points relatively close to a transmitting antenna (that is, in the region where the induction field component is significant). The near fields produced by a vertical electric or magnetic dipole over a plane boundary, such as water or flat terrain, are considered in detail.

Quantum Mechanics—Electromagnetic and Matter-Wave Analogs, E. J. Schillinger and J. J. Hupert ..... Feb 53
Quantum mechanics is the key to understanding newer electronic devices. For the engineer with training and practice in the disciplines of electrotechnology, this article provides a lucid introduction to quantum mechanics by stressing the analogies between matter waves and the more familiar electromagnetic-field behavior.

Solid-State Principles, A. H. Seidman ..... Dec 57
After a development of necessary background material, the operation of the semiconductor diode and the transistor are analyzed. Then, the field-effect transistor, silicon controlled rectifier, Hall-effect device, and tunnel diode are discussed. The approach is semiquantitative; emphasis is on physical theory.

Systems Theory

Mathematical Models for Control Systems, R. Feit ..... Mar 69
Principles of the use of mathematical models (equations) are explained as a means of avoiding the necessity for building expensive, complicated mechanical models. Use of the technique is illustrated in applications to electrical and hydraulic systems in a study to determine their individual advantages and disadvantages.

Optimal and Adaptive Control Systems, S. M. Shinners..... Jul 63
The latest methods of design and analysis of complex control systems are presented. These systems cannot be treated with older, more conventional methods. Optimal systems focus on the realization of an optimum, static, operating condition. Adaptive systems involve automatic correction for variations in system parameters—often caused by environmental changes.

SYSTEMS (see CIRCUIT DESIGN)

Communication

Delta Modulation, R. H. Maschhoff ..... Jan 91
Basic delta modulation is explained. Performance of conventional and modified delta-modulation systems is discussed. Typical applications to voice and video communications and to control systems are given. Delta modulation is compared to PCM and PRM.

Digital Computers in Communications Design, D. Wood, J. P. Healy and R. Lee..... Feb 39
Communications components are described by general, standardized network models, designed for digital computer calculations. Recursion forms for symmetrical-lattice, inverted-L and bridged-T networks are given. Synthesis and analysis of filters is discussed and a Fourier-analysis method is presented.

A Two-State Modulation System, A. G. Bose..... Aug 42
A modulation system which converts a continuous signal into a two-state signal is described. The system combines frequency and pulsewidth modulation to provide a closed-loop system with a nonlinear forward path and a linear, passive feedback. Applications to high-efficiency power amplification and nonlinear control are presented.

The NBS and Measurement Standards, An Electro-Technology Staff Report ..... Oct 91
A review of basic and engineering measurement standards developed by the National Bureau of Standards to meet increasing demands for higher accuracies and wider ranges. Areas include electricity and general metrology as well as radio engineering, radio propagation, and cryogenics.

A New Look at the Parallel Tuned Circuit, D. E. Mertens..... May 58
Parallel RC and RLC circuits are examined over the entire frequency spectrum using a Bode-plot approach. Impedance, bandwidth and parameter variation are analyzed and appropriate approximations are suggested.

Satellite Communications, H. P. Hutchinson ..... Apr 44
Basic considerations in the design of a satellite communication relay are surveyed. Orbits most favorable for communication are examined. Problems in satellite design (power supply, stabilization) and ground-station design (sensitivity, tracking accuracy) are considered. Sources of transmission loss are discussed.

Computing; Data; Recording

Digital Audio-Conversion System, H. Grunstein and H. Van Gelder..... Feb 108
A system capable of giving simultaneous, vocal replies to 1000 questions over separate telephone lines is described. Operation of the 60-word audio drum storage unit and multiplexing arrangement is discussed.

Optical Character-Recognition Systems, H. Falk .. Jul 42
The operating principles of a variety of OCR systems are described, including scanning methods, recognition methods and position-location techniques. A number of existing OCR systems are listed and a selected bibliography is given.

Control

Delta Modulation, R. H. Maschhoff ..... Jan 91
Basic delta modulation is explained. Performance of conventional and modified delta-modulation systems is discussed. Typical applications to voice and video communications and to control systems are given. Delta modulation is compared to PCM and PRM.

Digital Techniques for an Attitude-Control System, C. S. Burlingham and H. C. Daubert, Jr. Apr 34
Certain classes of spacecraft require precise control of angular position and rate with respect to reference coordinates. Null-seeking analog control can be effective in such cases; however, accuracy and stability are difficult to obtain when offset pointing over a wide range is used. Digital techniques and data processing show promise of a satisfactory solution to such problems.

Frequency Response through Impulse Excitation, J. K. Scully..... Jul 53
A technique is described by which frequency-response characteristics may be obtained directly from the system's response to impulse excitation. The implementation of the method for a dynamic analyzer is presented and the coefficients of the compensating networks are derived.

SCR's in Automatic Power Control, B. Berman ... Dec 106
The combination of SCR's and magnetic amplifiers (for gate triggering) provides control of both the armature and the field of the motor to achieve constant torque and constant horsepower ranges.

SCR Phase Control of Inductive Loads, F. W. Gutzwiller..... Apr 119
Use of silicon controlled rectifiers (SCR's) in systems which operate off of standard supply lines (120, 240 volts) is described. In particular, circuit designs of control systems where the load is inductive (transformers, motors, etc.) are shown.

Stability of Closed-Loop Control Systems, A. W. Langill ..... Feb 77
A thorough investigation and description of the use of frequency responses in analyzing systems for stability. Although the method is an experimental technique, it must be used often

when other methods such as root locus and transfer function cannot be used.

State-Variable Techniques for Control Systems, M. G. Rekoff, Jr. ..... May 36
In the design of complex control systems, where the control functions become very sophisticated, conventional methods (root locus, frequency response, etc.) are inadequate for synthesizing and analyzing the systems. State-variable techniques are applicable to linear, nonlinear, and sampled-data systems. Their use is mandatory in the design of controls for optimum system performance.

A Two-State Modulation System, A. G. Bose..... Aug 42
A modulation system which converts a continuous signal into a two-state signal is described. The system combines frequency and pulsewidth modulation to provide a closed-loop system with a nonlinear forward path and a linear, passive feedback. Applications to high-efficiency power amplification and nonlinear control are presented.

Drive; Propulsion

Block Diagrams of Rotating Machines, R. S. Peterson ..... Jan 30
Part 1. The first of a two-part article dealing with the reduction of rotating machines (a-c and d-c) to block-diagram form. The diagrams facilitate the analysis not only of the machine and its associated drive components but also of the over-all system (feedback or open-loop) in which the drive is to be used.

Block Diagrams of Rotating Machines, R. S. Peterson ..... Feb 44
Part 2. The block diagrams for adjustable a-c drives are presented. System components analyzed include clutch devices, primary saturable reactors, and eddy-current couplings. Two specific examples and a set of rules for simplifying diagrams are presented.

Electric Propulsion—An Introduction, G. F. Watson ..... Apr 39
Electric propulsion systems are characterized by high specific impulse, making them suitable for extended space missions. The basic types of electric engines—electrostatic, electromagnetic, and electrothermal—are discussed. Operating principles, state of development, and relative merits of each are reviewed.

Navigation; Guidance; Surveillance

Radar Detection, J. V. DiFranco and W. L. Rubin..... Apr 61
Basic principles of radar detection are given along with a detailed examination of several target models. Necessary background material in statistics and probability is concisely presented. Characteristics of constant amplitude, Rayleigh and "one dominant plus Rayleigh" signals for both single- and multiple-hit detection are examined. Both graphical and analytical design methods are used.

Test and Measurement Systems

Nuclear-Resonance Sensing of Mechanical Motion, R. Zito, Jr..... Jun 43
A device employing nuclear radiation sources (radio-isotopes) in conjunction with suitable detectors can be used to provide precise mechanical position and velocity measurements. The Mossbauer effect is utilized by a resonant gamma-ray detector for the quantitative sensing of relative motion.

TEST AND MEASUREMENT

Environmental Testing

Solar Simulation for Testing, A. E. Mann and F. N. Benning ..... Oct 60
Rising demand for accurate simulation of space-radiation environment creates problems in test-facility design and techniques. The nature of the problems and solar-simulation developments to date are described.

Instruments; Equipment; Techniques

Audible Noise and Vibration Measurements, J. A. Jensen ..... Oct 101
The importance of noise tests in locating mechanical defects in engineering models is described, and the practical problems of isolating the test object from background noise and unwanted vibration are discussed. Requirements for instrumentation are given.

Infrared Measurements, R. Saul ..... Oct 112
The methods and instruments (for both laboratory and field) which are used in determining infrared power, emissivity, radiation, etc., are described.

Measurement of Large Direct Currents, P. Covert. Oct 106
A precise current transductor, designed around magnetic-amplifier bridge circuits, is described. Two methods of calibrating the instrument are discussed, one being a current comparator using refinements of the basic magnetic-amplifier transductor.

The NBS and Measurement Standards, An Electro-Technology Staff Report ..... Oct 91
A review of basic and engineering measurement standards developed by the National Bureau of Standards to meet increasing demands for higher accuracies and wider ranges. Areas include electricity and general metrology as well as radio engineering, radio propagation, and cryogenics.

The Ratiometric Measurement Principle, L. Julie.. Oct 54
Degrees of measurement accuracy and repeatability which were formerly demanded only of primary-standards laboratories are now required of the industrial laboratory. A basic measurement principle has been developed which offers a technique for readily obtaining new orders of accuracy and reliability of calibration and certification of electrical quantities.

UHF Measurements, M. Magid..... Oct 67
Basic considerations in measurements at microwave frequencies are discussed. Measurement of impedance, frequency phase shift, power and attenuation, and insertion loss are treated. Emphasis is given to the principles of the measuring systems and to the possible sources of measurement error.

Uncertainties in Measurement, R. P. Benedict..... Oct 51
Uncertainty in a result is related to uncertainties in measurements of variables. The maximum uncertainty of a result that is related to one or more measured variables can be determined for many common functional forms by the use of a few simple rules.

Specifications and Standards

The NBS and Measurement Standards, An Electro-Technology Staff Report ..... Oct 91
A review of basic and engineering measurement standards developed by the National Bureau of Standards to meet increasing demands for higher accuracies and wider ranges. Areas include electricity and general metrology as well as radio engineering, radio propagation, and cryogenics.

Testing of Components

Built-In Reliability, F. A. Applegate ..... Oct 40
A comprehensive reliability program to obtain a product with built-in reliability is described, together with methods for collecting and analyzing reliability data. Techniques to achieve economical testing and manufacturing are outlined.

Extrapolating Component Life Tests, C. L. Toye .. Oct 36
A summary is presented of the techniques used to estimate component-reliability extrapolating time and environment. Methods discussed ex-

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tend from simple time, stress and Arrhenius extrapolation to the more advanced matrix life testing, multiple-regression analysis, and contour plotting. Advantages and disadvantages of each technique are considered.		
Hysteresis Motor Flutter, N. A. Miller. If the two component fields in a hysteresis split-phase motor are not balanced and in 90-deg time phase, or if saturation exists, the motor will exhibit flutter. Methods of flutter measurement and control are outlined.	Jul	123
Relay Tests Focus on Contact Performance, F. J. Oliver. Selected abstracts of papers presented at the 12th National Relay Conference, Oklahoma State University, April 28–30, emphasize the need for more sophisticated test methods as heretofore minor contact defects become major ones in the face of the needs of aerospace and data-handling systems, which involve low power levels and high reliability.	Jul	91
Testing Four-Layer Switching Devices, K. D. Pope III and R. A. Mammano. Various circuits and techniques are given for measuring the various important parameters (from the user's standpoint) of four-layer semiconductor devices—in particular, silicon controlled rectifiers.	Dec	99
Testing of Systems		
Cryogenically Cooled Motors, J. H. Redmond and F. W. Bott. Tests demonstrate the feasibility of operating essentially open-frame a-c and d-c motors submerged in liquid hydrogen and liquid nitrogen. Higher horsepower per pound, greatly increased efficiency and simplification of motor-pump systems design are among the significant advantages to be obtained in such environments.	Jul	83
Frequency Analysis of Noise, E. F. Feldman. The types of signals encountered in waveform analysis are summarized. Their definitions in terms of measurement parameters are reviewed and the calibration techniques necessary to standardize receivers and spectrum analyzers for quantitative level measurements are described.	Jun	36
Frequency Response through Impulse Excitation, J. K. Scully. A technique is described by which frequency-response characteristics may be obtained directly from the system's response to impulse excitation. The implementation of the method for a dynamic analyzer is presented and the coefficients of the compensating networks are derived.	Jul	53
Infrared Measurements, R. Saul. The methods and instruments (for both laboratory and field) which are used in determining infrared power, emissivity, radiation, etc., are described.	Oct	112
Predicting System Checkout Error, W. D. Moon. During system and component testing there may be either a failure to detect an existing defect or the false detection of a nonexistant defect. This article discusses methods to estimate both types of test errors. The probability equations developed may also be used to specify the design of new test equipment.	Jan	46
Progress in EMC Instrumentation, D. R. J. White. Problems in electromagnetic-compatibility measurement which could be solved by application of techniques from other fields are discussed. Such problems include measurement of attenuation in an enclosure, antenna-pattern measurement, and electromagnetic surveys. Equipment and systems for such measurements are proposed.	Oct	46

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- Filter
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- Power Supplies, Regulators
- Semiconductor
- *Other*

Components, Electrical/Electronic
- Capacitors
- Contact Devices (switches; relays)
- Electron Tubes
- Inductive Components (transformers; inductors)
- Integrated Modules
- Magnetic Devices
- Microcircuit Assemblies
- Microwave Components
- Motors, Instrument
- Motors, Power
- Optical and Infrared Devices
- Photoelectric Devices
- Power Sources, Supplies
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- Semiconductor Devices
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- Wire and Cable
- Wiring Devices (connectors; terminals)
- *Other*

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- Materials Science
- Mathematics
- Measurement Theory
- Network Theory
- Physics
- Systems Theory
- *Other*

Systems (see *Circuit Design* above)
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- Control
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- Power, Electrical
- Test and Measurement Systems
- *Other*

Test and Measurement
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- *Other*